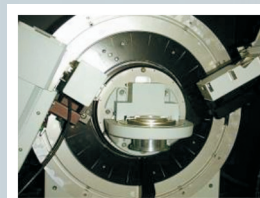
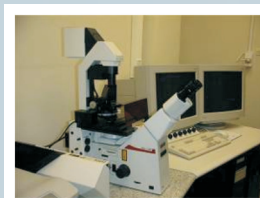
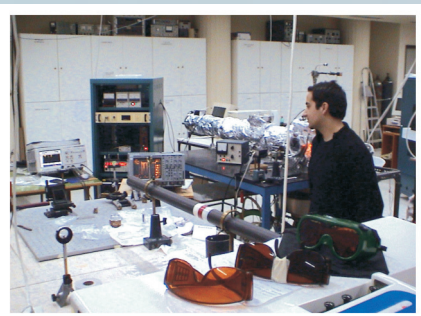




University
of Ioannina

NETWORK OF RESEARCH SUPPORTING LABORATORIES

IOANNINA 2010





**UNIVERSITY OF
IOANNINA**

**NETWORK
OF RESEARCH SUPPORTING
LABORATORIES**

IOANNINA • 2010



**NETWORK OF RESEARCH SUPPORTING LABORATORIES
OF THE UNIVERSITY OF IOANNINA**

<http://www.uoi.gr/services/lab-net/>

The description of individual Laboratories was based on contributions from the Network's Scientific/Technical Staff who provided the required text and data

Executive Editor

Ioannis Gerothanassis

Editing, Design and Formatting

Christina Papachristodoulou

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Preface

As part of its mission and regional policy, the University of Ioannina constantly evolves and complements its infrastructure, aiming to increase its competitiveness, to support high quality research and to establish links with the local society. This endeavor is of critical importance in order to enhance scientific excellence, thus sustaining the Institute dynamics and creating a high academic added-value, both at the regional and national level. To realize its policy, the University of Ioannina had the full support of the General Secretariat of the Epirus Region ever since 1994. The “Network of Research Supporting Laboratories” constitutes a distinguished common action that promotes the role of the University and contributes to the perspective of development in the Region.

The guide at hand provides a brief description of the Network, highlighting its main goals and introducing each member-Laboratory, with special emphasis on the scientific field, the available infrastructure, the human potential, the services provided and the recent published work. It is thus hoped, not only to demonstrate the Network activities, but also to pursue cooperation with research groups beyond the University of Ioannina.

The description of member-Laboratories was based on material provided by the Network’s Scientific/Technical Staff, while the overall editing and formatting was realized by C. Papachristodoulou. Their contribution is sincerely appreciated.

Ioannina, July 2010

Professor Ioannis Gerothanassis

Rector of the University of Ioannina

THE NETWORK OF RESEARCH SUPPORTING LABORATORIES AT THE UNIVERSITY OF IOANNINA (UOI-LabNet)

THE UOI-LabNet

A Laboratory Network has been established in the University of Ioannina, with the goal to encourage the basic and applied research carried out in various academic Departments. This endeavour was initially funded in 1999 by the Regional Operational Program (ROP) of Epirus and continues to receive financial support from the General Secretariat of the Epirus Region, the University of Ioannina and other funding sources.

The Network aims primarily:

- to promote large-scale research activities focusing on cutting-edge scientific fields,
- to enhance cooperation between research groups within the University of Ioannina,
- to improve the scientific research impact of the University of Ioannina,
- to increase effectiveness in receiving research funding,
- to support educational activities at the undergraduate and post graduate level.

As part of its strategic policy, the University of Ioannina makes constant provision for expanding the Network's infrastructure, for providing the Network with expert scientific and technical staff and carrying out evaluation procedures.

STATUTORY FRAMEWORK

The Network of Research Supporting Laboratories has first received a legal status through the Internal Regulation of the University of Ioannina, published in the Official Journal of the Hellenic Republic (Sheet No 310, 10-3-2005). As indicated in statute 48, paragraph 2 therein, the Network has been established “...to meet the research needs of the University of Ioannina staff members, post graduate and undergraduate students, as well as to provide services to external users”.

In August 2009, following a long period of elaborations and amendments, the University Senate has approved the final Statutes of the Network, covering all issues related to its function.

EVALUATION PROCEDURES

According to the Network Statutes, evaluation procedures are to be conducted on a regular basis, addressing the quality of services provided by the Network Laboratories, as well as their scientific impact on research carried out in the University of Ioannina.

The most recent evaluation was performed at the beginning of 2010 by internal Evaluation Committees, appointed by the University Senate Research Council. A series of evaluation criteria were adopted for all participating Laboratories, with special focus on the research field covered by each Laboratory, the competence in infrastructure and manpower, the number and

variety of researchers interested in using each Laboratory, the scientific impact of provided services, the contribution to educational activities, the future perspectives etc.

In the final Evaluation Report (available online, in greek, at <http://www.uoi.gr/services/lab-net/evaluation.html>), recommendations are given concerning the Laboratories that fulfill the above criteria and should be part of the Network, the Laboratories that fail to meet these criteria and should be excluded and the Laboratories that should put additional effort to meet the criteria before being re-evaluated.

Generic issues have also been considered and the Evaluation Committees made a series of suggestions, such as setting a Code of Operating Rules for the Network Laboratories, initiating procedures for designating expert scientific and technical personnel, ensuring alternative funding to cover operating costs, pursuing the expansion of the Network and the enhancement of the existing infrastructure.

All recommendations and suggestions were approved by the University Senate and follow-up actions are already in place.

UNITS & CENTERS OF THE UOI-LabNet

Following a recent internal evaluation procedure, the Laboratory Units and Centers that are currently qualified to be part of the Network, include:

- Nuclear Magnetic Resonance (NMR) Center
- Scanning Electron Microscopy (SEM) Unit
- Confocal Laser Scanning Microscopy Unit
- Powder X-ray Diffraction (XRD) Unit
- Single-Crystal X-ray Diffraction (XRD) Unit
- X-ray Fluorescence Spectroscopy (XRF) Unit
- Mass Spectrometry Unit
- Archaeometry Center
- Central Laser Facility
- Magnetic Measurements Unit
- Thermal Analysis Unit
- Cancer Biobank Center
- Research Center for Scientific Simulations

Other Laboratories that have been developed and will be evaluated for joining the Network in the near future, are listed below:

- Food Quality Certification Unit
- Stem Cell Unit
- Laboratory of Nanotechnology
- Automated Unit for Microscope Plates Reading
- Laboratory for Observing and Modeling the Human Behavior
- Multiple Analysis Application Unit using DNA Microarray

A brief description of each Network Laboratory is given in the following sections, emphasizing on the research field, the available infrastructure, the services provided, the scientific and technical human potential and the published work of each Unit/Center.

Nuclear Magnetic Resonance Center

Introduction

The Nuclear Magnetic Resonance (NMR) Center, which was incorporated in the Network of Horizontal Laboratory Units and Centers (and from 2010 to the Network of Research Supporting Laboratories) of the University of Ioannina in 1999, has a multi-scientific and technological character and addresses pure and applied research in the Chemistry, Physics and Medicine Departments, the Department of Materials' Science and Technology and the Department of Biological Applications and Technologies, of the University of Ioannina, as well as the Regional University Hospital of Ioannina. Furthermore, the NMR Center is directly linked to the Institute of Biomedicine Research and the technological Park of Epirus (Fig. 1).

Nuclear Magnetic Resonance Spectroscopy is based on nuclear magnetic moment transition within a strong static and homogenous magnetic field B_0 . These transitions are caused by the application of an electromagnetic irradiation in the region of 1000 – 10 MHz depending on the field strength. The resonance frequency of a particular nucleus, such as ^1H , is not constant but it depends on the electronic environment of the proton (Fig. 2). Based on this property NMR has made a tremendous impact, at a molecular level, in many areas of chemistry, biology and medicine.

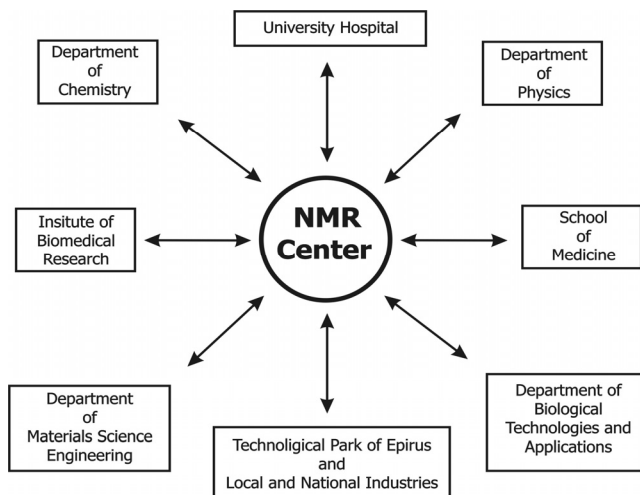


Figure 1: Links between the NMR Center and other Institutions of Epirus.

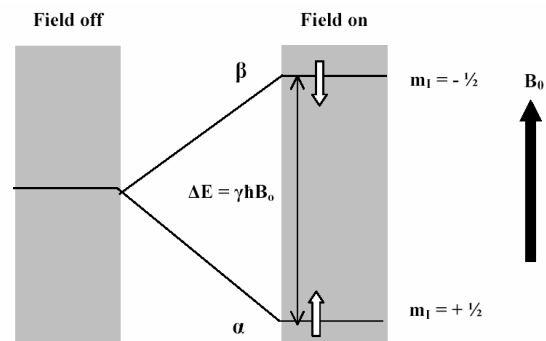


Figure 2: The nuclear spin energy levels of ^1H nucleus in a magnetic field.

Infrastructure

Since 1995, the NMR Center is lodged in specially tidied up rooms, at the Department of Chemistry of the University of Ioannina. The facility was expanded at 2006. The instrumentation consists of:

- A Brücker AV-250 spectrometer (resonance frequency of ^1H 250 MHz) that has been installed since March 1999 (Fig. 3). It has been bought in the frame of EPEAEK “Bio-inorganic Chemistry” and with the subsidy of the deanery of the University of Ioannina. This instrument is suitable for acquiring routine spectra and for teaching purposes. The AV-250 has been recently updated to both hardware and software.
- A Brücker AV-400 spectrometer (resonance frequency of ^1H 400 MHz), with the capabilities of obtaining high-resolution spectra in the liquid and solution state and with the future possibility for NMR spectra in the solid spectra (Fig. 4). This instrument has been supplied with suitable accessories, so it can work in a wide range of temperatures and with almost all the magnetically active nuclei of the Periodic Table. The instrument has been bought through the EEC Stride-Hellas 33 program, in which research groups of the Department of Chemistry and the School of Medicine participate, with further subsidy from the University of Ioannina and public investments of the Department of Chemistry. In 1997, the instrument was further equipped with a field z-gradient probe, which is appropriate for NMR studies of biological macromolecules in aqueous solution. The AV-400 has been recently updated to both hardware and software. At 2009 a laser unit was supplied that would be hyphenated to the AV400 system.
- A Brücker AV-500 spectrometer (resonance frequency of ^1H 500 MHz) hyphenated with LC-SPE system, the latter equipped with a solvent delivery pump, a DAD UV detector and a Prospect 2 solid phase extraction (SPE) unit (Fig. 5). All individual components are connected in line to produce LC-SPE-UV-NMR hyphenation. This modern instrumentation was sponsored by the Greek Community Support Framework III, Regional Operational Program of Epirus 2000 – 2006 (MIS 91629). Moreover the AV500 was equipped with a cryogenic platform and a cryo TXI -probe head (Fig. 6). The latter can be easily “converted” to flow probe and work in flow mode after the necessary modification through the mounting of a flow inlet.

The running cost of the instruments of the Center is about 16.900 € per year. The payment of the technician or the technicians of the instruments of the NMR Center, the outlet of the fixed consumables (liquid He and liquid N_2) and the repairing of the instruments are covered by the budget of the University of Ioannina.



Figure 3: General view of the Brücker AV-250 spectrometer (resonance frequency of ^1H 250 MHz).



Figure 4: General view of the Brücker AV-400 spectrometer (resonance frequency of ^1H 400 MHz).



Figure 5: General view of the Bruker AV-500 spectrometer (resonance frequency of ^1H 500 MHz) and the LC-SPE system.



Figure 6: The cryo-unit that is connected to the cryoprobe at the AV500 system.

FUTURE DEVELOPMENT

Computational Facilities

Three workstations are available to the users for data manipulation. The two of them have the Top-spin suite and the third has additionally the AMIX –Aurelia suite.

Moreover, a computer cluster with several PCs working in the Linux environment will be acquired in the next few months, for facilitating the NMR data acquisition, data retrieval and database integration. Several bioinformatics tools will be installed for protein structure determination, protein structure databases, protein-ligand docking, etc.

Solid state accessories on the AV-400

With this experimental setting, it would be possible to characterize both the structure and dynamics in the solid state of various systems of interest from the academic and industrial point of view.

New NMR instrumentation

There will be an increasing demand for NMR equipment in the next few years. The increased need will be both quantitative (number of instruments) and qualitative (higher fields). Furthermore, an exponential increase in number of biological systems to be investigated (quantity) as well as in complexity of these systems (quality) will be expected. The expansion, therefore, of the NMR Center with a high field (greater or equal to 700 MHz) NMR instrument, fully equipped with multinuclear and multidimensional (3D and 4D) capabilities, is of high priority. Moreover, in order to cover all the kind of samples, the purchase of a solid state NMR is of high priority.

Services

The main objective of the NMR Center is to offer the know-how in a cost-effective way and in collaboration with:

- Research groups of the University of Ioannina and other Greek Universities
- Research centers
- Hospitals
- Industries

in the following fields of basic and applied research:

Synthesis and structural studies of new chemical compounds with emphasis on drug design and biotechnological products

Modern NMR techniques contribute significantly in controlling synthetic pathways and in performing conformational studies of a wide range of compounds of biological and pharmaceutical interest. With the recently developed multinuclear and multidimensional NMR techniques, the above studies can be extended to much more complicated biological molecules (such as proteins in complexation with drugs), which can contribute in the field of drug design.

Materials

NMR is a powerful technique (sometimes being the only method of choice) for the study of new materials of technological interest, such as glasses, ceramics, polymers, synthetic membranes etc.

NMR spectroscopy in the solid phase can be used to investigate reactions taking place in catalytical surfaces, which have important financial and technological benefits. Catalysis includes many important fields of applications such as oxidation, corrosion and formation of hyperfine films of technological interest.

Food analysis

NMR spectroscopy can be used in the verification of the wine aging and authenticity, as well as in the identification of the oil's fatty constituents and the various extracts of natural products. It can also contribute in the investigation of the mechanisms that are responsible for food decomposition, without requiring sample destruction in contrast to the classical chemical analysis techniques.

Clinical applications

NMR can be used in the location and characterization of metabolites in biological fluids in vivo and ex vivo and thus, can be utilized in the diagnosis of many kinds of diseases.

Environmental applications

NMR spectroscopy contributes in the study of environmental issues, concerning air and subsoil pollution (e.g. retention of organotoxic compounds from humic acid).

EXPERIMENTAL TIME FOR THE USAGE OF THE NMR CENTER FACILITIES

Figure 6 displays the experimental time occupation of the NMR center facilities. Especially for the AV 500, the cryoprobe resulted in a significant increment of the experimental time occupation.

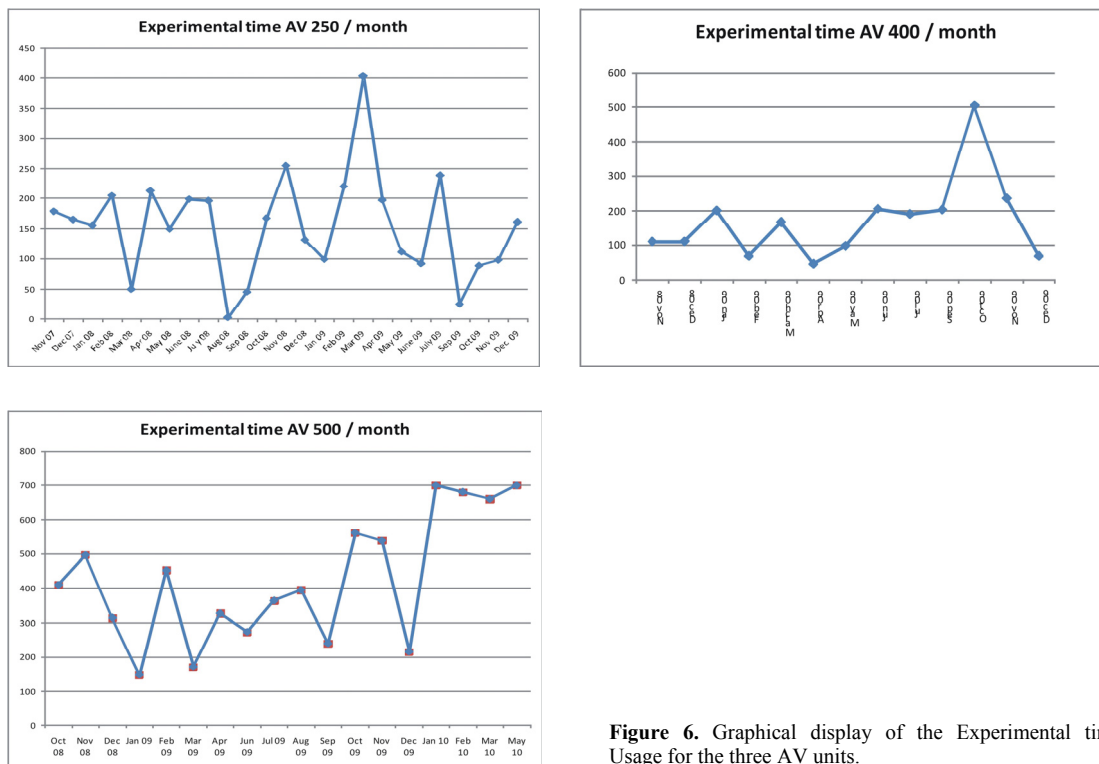


Figure 6. Graphical display of the Experimental time Usage for the three AV units.

Staff & Contact Information

A Scientific Committee, consisting of academic staff members of the University of Ioannina, is responsible for the operation of the Center, the improvement of its equipment and the rendering of services. A scientist with a PhD in NMR-related subjects and post-graduate experience abroad is responsible for the instruments. He/she is in charge of obtaining routine and complicated spectra, providing education to researchers and ensuring the normal operation of the instruments.

Additional information concerning the NMR Center can be obtained from Prof. I. Gerothanassis who is the chairman of the Administrative/Scientific Committee:

Postal address: Organic Chemistry Laboratory, Chemistry Department, The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08389

Fax: +30-26510-08799

E-mail: igeroth@cc.uoi.gr

Representative Publications

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It is noted that more than one hundred (100) articles have been published in international scientific journals, during the first eight years of operation of the NMR Center. Additionally, during the last 5 years (2004-2009), 26 M.Sc.s and 16 Ph.D.s have been supported by the NMR Center facilities. Furthermore during the above time period, 47 scientific publications in international journals have cited and acknowledged the NMR center facilities.

Scanning Electron Microscopy Unit

Introduction

Electron microscopy is a straightforward technique to determine the size and shape of particles. It can also reveal information on particle composition, for example by detecting X-rays, which are produced by the interaction of the electrons with matter, or by analyzing the way in which the electrons are diffracted. Electrons have characteristic wavelengths in the range of 0.1-1 nm (visible light: 400-700 nm) and some close to seeing atomic detail. The interactions of the primary electron beam (100-400keV) with the sample are summarized in Fig. 1:

- Depending on sample thickness, a fraction of the electrons passes through the sample without suffering any energy loss. These electrons are used in transmission electron microscopy (TEM).
- Electrons are diffracted by particles that have a favorable orientation towards the beam, enabling one to obtain crystallographic information.
- Electrons can collide with atoms in the sample and be scattered back; back scattering is more effective when the mass of the atom is increased.
- X-rays and Auger electrons are formed in the relaxation of core-ionized atoms, as discussed in the sections on AES and XPS.
- Electrons excite characteristic vibrations in the sample, which can be studied by analyzing the energy loss suffered by the primary electrons.
- Many electrons loose energy in a cascade of consecutive inelastic collisions. These are called secondary electrons; most of these had their last loss process in the surface region just before leaving the sample.
- The emission of a range of photons from UV to infrared is called cathodoluminescence and is caused by the recombination of electron-hole pairs. Thus, the interaction of the primary beam with the sample provides a wealth of information on morphology, crystallography and chemical composition.

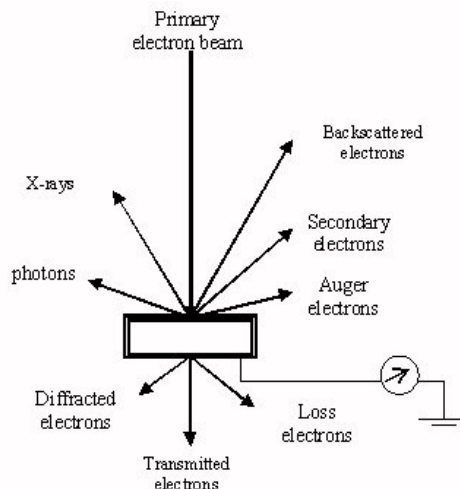


Figure 1: The interaction of the primary electron beam with a sample in electron microscopy produces a wealth of detectable signals.

Scanning electron microscopy (SEM) is carried out by rastering a narrow electron beam over the surface and detecting the yield of either

secondary or back-scattered electrons as a function of the position of the primary beam. Contrast is caused by the orientation: parts of the surface facing the detector appear brighter than parts of the surface pointing away from the detector. The secondary electrons have low energies (10-50 eV) and originate from the surface of the sample. Back-scattered electrons come from deeper and carry information on the composition of the sample, because heavy elements are more efficient scatterers and appear brighter in the image. Dedicated SEM instruments have resolutions of about 5 nm. Simple versions of SEM with micron resolution are often available on Auger electron spectrometers, for the purpose of sample positioning. The main difference between SEM and TEM is that SEM sees contrast due to the topology of a surface, whereas TEM projects all information in a two-dimensional image, which is of sub nanometer resolution. A TEM instrument combines the two modes of electron microscopy.

As illustrated in Fig. 1, an electron microscope offers additional possibilities for analyzing the sample. Diffraction patterns (spots from a single-crystal particle and rings from a collection of randomly oriented particles) enable one to identify crystallographic phases as in XRD. Emitted X-rays are characteristic for an element and allow for a determination of the chemical composition of a selected part of the sample (typical dimension 10 nm). This technique is called electron microprobe analysis (EMA, EPMA) or, referring to the usual mode of detection, energy dispersive analysis of X-rays (EDAX or EDX).

Infrastructure

The SEM equipment consists of a JEOL JSM-563 unit connected to an OXFORD LINK ISIS L300 for EDX analyses. It is located in the Department of Chemistry (Figure 2).

The development of the SEM unit in the future will necessitate the acquiring of a Scanning Tunneling Microscope (STM) as well as an Atomic Force Microscope (AFM) which represent the latest development in the field of microscopy for observation of matter at atomic level.



Figure 2: General view of the S.E.M. (Scanning Electron Microscopy) Unit

Services

The SEM unit provides services to Research groups of the University of Ioannina, other Universities and Research Institutes. Specifically, the following kind of support can be provided:

Research activities

Support of the research activities of various groups in the Departments of Chemistry, Physics, Medicine, Archeology, Materials Science and Technology. Relevant topics include study of texture of surfaces of materials, definition of the microstructure of solids and studies of textural composition of archaeological objects.

Industrial activities

Control, identification and characterization of products from metallurgical units, silver smith small medium enterprises, food industry, pharmaceutical industries etc.

Environment

Interaction of pollutants with soil samples, identification of pollution aerosols etc.

Staff & Contact Information

A Scientific Committee, consisting of staff members of the University of Ioannina is responsible for the SEM Unit. Information can be acquired from Prof. P. Pomonis.

Postal address: Laboratory of Industrial Chemistry, Chemistry Department,
University of Ioannina 451 10 Ioannina, Greece

Tel: +30-26510-08350

E-mail: ppomonis@cc.uoi.gr

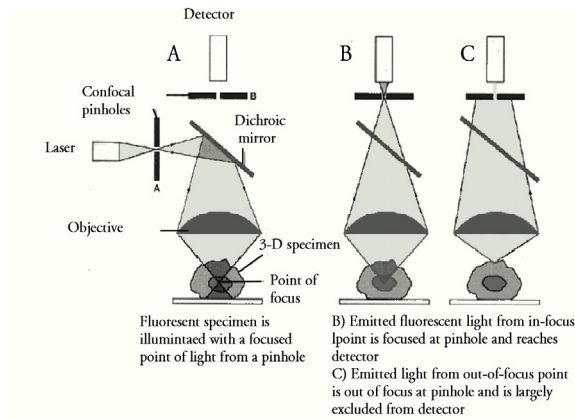
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Confocal Laser Scanning Microscopy Unit

Introduction



The confocal microscope has the ability to focus on one level and reject light deflected from levels out of focus (Fig. 1). Scanning one level after the other, the computer reconstructs the three-dimensional structure of the sample by processing the images from all levels. The confocal microscope functions similarly to the computerized tomography, which is used for diagnostic purposes and electronically sections the human body in sequential levels. Of course, the confocal microscope uses much smaller samples, even one single cell. This system has wide applications in contemporary molecular biomedical research.

Figure 1. The confocal laser scanning microscope.

Infrastructure

A Confocal Laser Scanning Microscope is installed in the School of Medicine. This system (Fig. 2) consists of:

1. An inverted immunofluorescence microscope (LEICA DM IRB E) equipped with all the necessary lenses and other accessories.
2. A laser scanning unit (LEICA TCS SP). This unit is the specialized part of the system and has the following main parts: 3 Confocal R/FI detectors, 1 monitor diode, 1 transmitted light channel (HF, PH) and an Ar/Kr laser.
3. Control Unit. This unit includes the computer system with all the software for image analysis.
4. Documentation unit. This unit consists of a high quality professional printer (Pictography 3000).



Figure 2. The confocal scanning microscope.

Services

The Confocal Microscopy Unit provides services to research groups of the University of Ioannina, other Universities and research Institutes.

Staff & Contact Information

A Scientific Committee, consisting of staff members of the University of Ioannina is responsible for the Confocal Laser Microscopy Unit. Information can be obtained from Prof. T. Fotsis:

Postal address: Laboratory of Biological Chemistry, School of Medicine
University of Ioannina 451 10 Ioannina, Greece

Tel: +30-26510-07560

E-mail: thfotsis@uoi.gr

Representative Publications

1. Papanikolaou, A., Papafotika, A., Murphy, C., Papamarcaki, T., Tsolas, O., Drab, M., Kurzchalia, T.V., Kasper, M., and Christoforidis, S. (2005). Cholesterol-dependent lipid assemblies regulate the activity of the ecto-nucleotidase CD39. *J Biol Chem* 280, 26406-26414.
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Powder X-Ray Diffraction (XRD) Unit

Introduction

Powder X-ray diffraction diagrams are routinely used, mainly for identification and structure evaluation of materials. Powdered samples of practically any material are suitable for examination, provided that the samples are air stable. The method is of key importance in materials synthesis and development.

Infrastructure

Hardware Equipment

The powder XRD unit is located in the Physics Department, University of Ioannina and is available for use from scientists of the Departments of Physics, Chemistry and Materials Science and Technology. The unit was purchased from BRUKER axs (D8 ADVANCE), is equipped with a Cu X-ray tube (Fe tube is also available) and works in θ - θ geometry (Figs. 1, 2). A variable divergence slit is located after the Soller slit of the divergence beam. The slit width is computer controlled, permitting the illuminated area of the sample to be from 1 to 20 mm. As illustrated in Fig. 3, the diffracted beam passes through the antiscatter and detector slits and through a Ni filter, before being monochromatized by a secondary monochromator (for Cu radiation). The system is capable of collecting data in the 1 - 180° 2θ range, for powder and oriented film samples.

The system is completely controlled by a PC, which is connected to the unit and serves for experimental setup control, data collection and analysis. The PDF-4 (Release 2009) database from the International Center for Diffraction Data is available on the same personal computer.

Software available

The following software has been installed on the computer.

DIFFRAC^{plus} Basic, data acquisition

This is the basic software for operating the diffractometer and provides:

- Control of the diffractometer
- Alignment of the goniometer
- Adjustment of the measurement electronics
- On-line display of measured data

DIFFRAC^{plus} Basic, data evaluation software EVA

This is an extensive graphics program for data evaluation and presentation, with the following features:

- Peak search and creation d/I – files
- Background subtraction
- Data smoothing
- $K\alpha_2$ stripping
- Calculation of line position, center of gravity, integrated area and half width.
- Overlay of several diagrams
- 3-dimensional presentation

DIFFRAC^{plus} RIETVELD

This software performs Rietveld analysis on powder diffraction diagrams.

DIFFRAC^{plus} SEARCH

This software permits full search in the PDF database.



Figure 1: General view of the powder X-ray diffractometer.

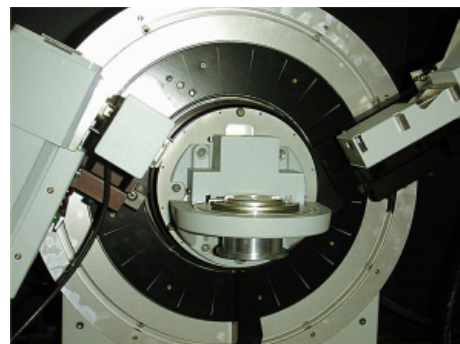


Figure 2: Close view of the powder X-ray diffractometer.

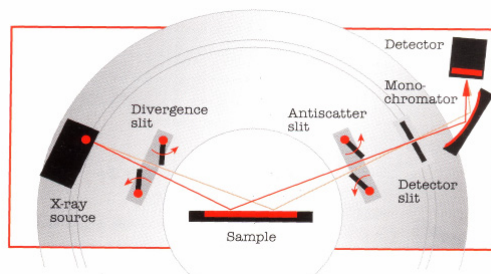


Figure 3: The typical geometry of X-rays diffraction from a flat sample.

Staff & Contact Information

A Scientific Committee, made up of staff personnel of the University of Ioannina is responsible for the X-ray powder Diffraction Unit. Information concerning the Unit may be obtained from Prof. T. Bakas (tbakas@cc.uoi.gr).

Postal address: Materials Physics Laboratory, Physics Department, The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08512

Fax: +30-26510-08690

Representative Publications

1. Origin of ferromagnetism in ^{57}Fe -doped NiO. Douvalis A., Jankovic L., Bakas T., *J. Phys. Cond. Matt.*, 19, 436203, (2007).
2. Structural and biological studies of organotin(IV) derivatives with 2-mercapto-benzoic acid and 2-mercapto-4-methyl-pyrimidine. Xanthopoulou M.N., Kourkoumelis N., Hadjikakou S.K., Hadjiliadis N., Kubicki M., Karkabounas S., Bakas T., *Polyhedron*, 27, 3318, (2008).
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Single Crystal X-Ray Diffraction (XRD) Unit

Introduction

Single crystal X-ray diffraction allows the determination of the three-dimensional structure of small molecules and macromolecules of any kind, such as organic molecules or biological macromolecules (proteins, DNA segments, viruses and ribosomes), alloys, and minerals. This information can then be used for the clarification of several important issues, such as the nature of chemical bonding, the mechanisms involved in important biological processes, questions related to the development of nanotechnology and so on.

Infrastructure

The University of Ioannina has recently acquired an automatic Siemens (now Bruker) P4 single-crystal X-ray diffractometer (Fig. 1). It consists of a 3kW X-ray generator, a four-circle goniometer, a scintillation detector and a computer (Pentium) equipped with the software required to run the diffractometer. A liquid nitrogen cryostat, for use in low-temperature data collection, was also provided. This, however, has never been used, due to the lack of an appropriate container for the liquid nitrogen.

This diffractometer is mainly designed to be used for small-molecule (molecules composed of 400-500 atoms) crystal structure determination. The crystal's unit cell and space group are also determined in the process. The equipment can also be used to determine the morphology of the crystal. Use of the cryostat would allow the collection of data at low temperatures, which is generally more expensive, but permits the determination of difficult structures (involving disorder) and charge density studies.

FUTURE DEVELOPMENT

The most immediate priorities are (a) to purchase a liquid nitrogen container to allow use of the cryostat and (b) to acquire SHELXTL software (Bruker patent) to be used in resolving crystal structures.

It is also very important that a new generation CCD (charge coupled device), with which all modern crystallography laboratories are equipped, be installed. CCD diffractometers have great capabilities and are frequently necessary in certain areas of research such as nanochemistry and supramolecular chemistry (see Tsoucaris, *Current Challenges on Large Supramolecular Assemblies*, Kluwer 1999 p. 130, and J. Atwood, *Science*, 285, 1999, p. 1049).



Figure 1: Bruker P4, single crystal X-ray diffractometer.

Lastly, it is appreciated that development of crystallography of biological macromolecules, which is of particular importance to biotechnology and pharmacy, will require the purchase of an appropriate X-ray diffraction system.

Staff & Contact Information

A Scientific Committee is responsible for the Single Crystal X-ray Diffraction Unit. Information can be obtained from S. Skoulika.

Postal address: Laboratory of Physical Chemistry, Chemistry Department,
University of Ioannina, 451 10 Ioannina, Greece
Tel: +30-26510-08446
E-mail: vskoul@cc.uoi.gr

Representative Publications

1. I. Ozturk, S. Filimonova, S.K. Hadjikakou, N. Kourkoumelis, V. Dokorou, E. Manos, J. Tasiopoulos, M.M.Barsan, I.S. Batler, E.R. Milaeva, Jan Balzarini, N. Hadjiliadis ‘Structural Motifs and Biological Studies of New Antimony(III) Iodide Complexes with Thiones’ *Inorganic Chemistry* 49 (2010) 488.
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X-Ray Fluorescence (XRF) Spectroscopy Unit

Introduction

The X-Ray Fluorescence (XRF) Spectroscopy Unit, located in the Nuclear Physics Laboratory, is a member of Laboratory Network for Research Support in the University of Ioannina. X-Ray Fluorescence Spectroscopy has long been recognized as a powerful technique for the qualitative and quantitative elemental analysis of a wide range of solid and liquid samples. Compared to other competitive techniques, such as Atomic Absorption Spectroscopy (AAS) or Inductively Coupled Plasma Spectroscopy (ICPS), XRF has the advantage of being non-destructive, multi-elemental, fast and cost-effective. Furthermore, it offers a fairly uniform detection limit across a large portion of the Periodic Table and is applicable to a wide range of concentrations from 100% to a few ppm.

As illustrated in Fig. 1, the method involves atom excitation by primary X-rays – originating either from a radioisotopic source or an X-ray tube – and subsequent detection of the X-rays emitted by the sample during the de-excitation process (fluorescence photons). The X-ray fluorescence spectrum of a sample reveals a number of characteristic peaks. The energy position of the peaks identifies the atoms present in the sample (qualitative analysis), whereas the peak intensity leads to the relative or absolute elemental composition of the sample (semi-quantitative or quantitative analysis).

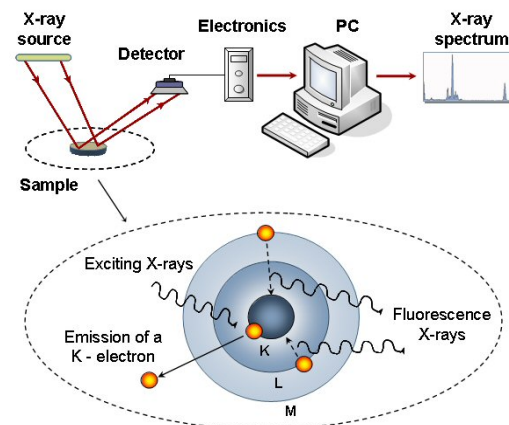


Figure 1: A schematic view of the XRF principle.

Infrastructure

A typical XRF arrangement consists of a primary irradiation source and a detection system for monitoring the secondary irradiation emitted by the sample. The XRF Spectroscopy Unit (Fig. 2) includes:

- Two radioisotopic sources: ^{109}Cd ($T_{1/2}=1.3$ y, 22.2 keV X-rays) and ^{241}Am ($T_{1/2}=470$ y, 59.6 keV X-rays). Combined measurements with the two sources allow the detection of elements from potassium (K) to uranium (U).
- A Si(Li) detector (CANBERRA, SL80175): 5-mm-thick crystal, 80 mm² active surface area, 25- μm -thick Be window, 171 eV resolution at 5.9 keV, liquid nitrogen cooling.
- A Si-PIN diode detector (Amptek X-123 complete X-ray spectrometer): 300- μm -thick, 6 mm² active surface area,

- 12.5- μm -thick Be window, 145 eV resolution at 5.9 keV, thermoelectrical cooling.
- A PC-based arrangement and software for data collection and analysis.
- A variety of Standard Reference Materials for calibrating the measuring setup.
- Standard laboratory equipment (grinders, mortars, sieves, furnace, balance, pellet press, freeze drier) for sample preparation.



Figure 2: A general view of the measuring arrangements operating in the XRF Spectroscopy Unit.

Services

The XRF Spectroscopy Unit provides a range of analytical services, which typically involve major and trace elements determination in a variety of samples. Most commonly analyzed samples include:

- soils and sediments
- archaeological ceramics and glass artifacts
- synthetic organometallic compounds, aluminosilicates, metal oxides etc
- natural water and industrial wastewater
- metals and alloys
- plant and animal tissues

Given the diversity of applications covered by the XRF technique, analyses are being requested by staff from various Departments of the University of Ioannina, while users from other Academic and Research Institutes, as well as local productive units are also interested in our services (Fig. 3).

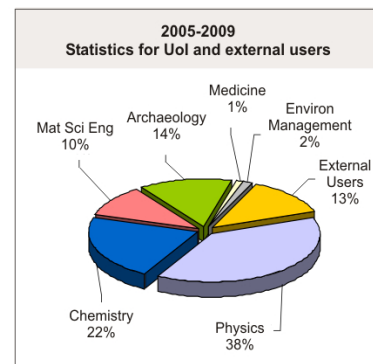


Figure 3: Unit statistics for University of Ioannina and external users (2005-2009).

The Unit further supports academic activities by contributing to students' education and practice, both at the undergraduate and post-graduate level.

Staff & Contact Information

The XRF Spectroscopy Unit is supervised by a Scientific Committee composed of academic staff members from the University of Ioannina.

Information can be obtained by contacting:

Kostas Ioannides (Head of the Unit), *E-mail*: kioannid@cc.uoi.gr, *Tel*: +30 26510 08545

Christina Papachristodoulou (technical staff), *E-mail*: xpapaxri@cc.uoi.gr, *Tel*: +30 26510 08545

Website: <http://omega.physics.uoi.gr>

Representative Publications

1. D. Karamanis, K.G. Ioannides and K.C. Stamoulis: *Determination of ^{226}Ra in aqueous solutions via sorption on thin films and α -spectrometry*. *Analytica Chimica Acta* 573-574 (2006) 319-327.
2. C. Papachristodoulou, A. Oikonomou, K. Ioannides, K. Gravani: *A study of ancient pottery by means of X-ray fluorescence, multivariate statistics and mineralogical analysis*. *Analytica Chimica Acta* 573-574 (2006) 347-353.
3. D. Karamanis, P.A. Assimakopoulos: *Efficiency of an Al-pillared montmorillonite on the removal of cesium and copper from aqueous solutions*. *Water Research* 41 (2007) 1897-1906.
4. D. Karamanis, K.G. Ioannides, K.C. Stamoulis: *Natural radionuclides and heavy metals in bottled water in Greece*. *Desalination* 213 (2007) 90-97.
5. C. Papachristodoulou, D. Patiris, K. Ioannides: *An X-ray fluorescence method for measuring the bulk etch rate of solid state nuclear track detectors*. *Nuclear Instruments and Methods B* 264 (2007) 177-182.
6. D. Karamanis, K. Stamoulis, K. Ioannides, D. Patiris: *Spatial and seasonal trends of natural radioactivity and heavy metals in river waters of Epirus, Macedonia and Thessalia*. *Desalination* 224 (2008) 250-260.
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Mass Spectrometry Unit

Introduction

Although the combination of gas chromatography with mass spectrometry (GC-MS) was first reported in 1958, made available commercially in 1967 and used widely for decades, many polar compounds are impossible to analyze with GC-MS. The need to combine the resolving power of liquid chromatography (LC) with the detection specificity of mass spectrometry (MS) for large biologically important molecules, led to the development of electrospray ionisation (ESI). This powerful technique was invented by Malcom Dole *et al.* in 1970 for mass spectrometry. His pioneering experiments demonstrated the use of electrospray to ionise intact chemical species. Twenty years later John Fenn demonstrated for the first time the use of ESI for the ionisation of high mass biologically important compounds and their subsequent analysis by mass spectrometry. For this work John Fenn was awarded a share of the 2002 Nobel prize for chemistry.

ESI, atmospheric pressure chemical ionisation (APCI) and nanoelectrospray ionisation (NSI) are complementary atmospheric pressure ionisation (API) techniques. Sample components are separated by HPLC and then introduced into the MS where single or multiple charged ions are created and detected. API is a soft ionisation method generating primarily molecular ions $[M + H]^+$, $[M - H]^-$, simple adduct ions $[M + Na]^+$ and ions representing simple losses, e.g. $[M + H - H_2O]^+$. Fragmentation of ions is rare. Multiple charges enable the detection of molecules as large as 150,000 u even though the mass-to-charge range for a typical LC/MS instrument is around 3000 m/z (e.g.: 100,000 u / 10 z = 1,000 m/z). Today, instruments that have more than one analyser, the so-called tandem (MS/MS) mass spectrometers, are used to provide information about the molecular weight, structure and sequence, identity and quantity of specific chemical components. LC-ESI works at atmospheric pressure at a flow rate of solute and solvent between 1 μ L/min and 1 mL/min. APCI works at similar flow rates and is used to detect less polar chemical components. NSI is a low (30-1000 nL/min.) flow rate version of ESI, more suitable for peptide and protein detection. LC-MS instruments are capable of "direct sample injection". Subsequent fragmentation of detected ions by MS/MS is reminiscent of the classical electron impact (EI) technique. Popular mass analysers for API instruments, include the quadrupole, ion-trap, Fourier transform-ion cyclotron resonance and time-of-flight analysers, depending on the requirements of an analysis.

Infrastructure

The Unit possesses an Agilent 1100 Series LC/MSD Trap System (Figure 1) that consists of the following components:

- (1) ion trap mass spectrometer, MSⁿ n = 11 (MSD trap, model SL),
- (2) atmospheric pressure interface: (a) electrospray ionisation, (b) chemical ionisation,
- (3) Agilent 1100 HPLC system (a) solvent cabinet, (b) degasser, (c) control module, (d) LC pump, (e) standard autosampler, (f) thermostated column compartment, (g) diode-array visible-UV detector,

- (4) monitor and computerized data acquisition/manipulation by Chemstation logistics,
- (6) binary pump,
- (7) nitrogen generator,
- (8) UPS system.

Figure 1: General view of the low resolution Agilent 1100 Series LC/MSD Trap System. Ion trap mass spectrometer (1) with its interface (2), the Agilent 1100 HPLC system (3), monitor (4) and computer (5) are shown, only.



Services

The Unit typically renders services in the following areas:

- Molecular weight determination of novel organic and inorganic materials
- Novel material characterization
- Clinical applications
- Environmental Applications
- Biochemical applications
- Food applications
- Pharmaceutical applications

Staff & Contact Information

A Scientific Committee, made up of staff personnel of the University of Ioannina is responsible for the Mass Spectrometry Unit. Information may be obtained from G. Varvounis.

Postal address: Mass Spectrometry Unit, Room X3-117β, Department of Chemistry,
University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08427, Fax: +30-26510-08799

E-mail: gvarvoun@cc.uoi.gr

Representative Publications

1. Louppis, A. P.; Badeka, A. V.; Katikou, P.; Paleologos, E. K.; Michael G. Kontominas, M G. Determination of okadaic acid, dinophysistoxin-1 and related esters in Greek mussels using HPLC with fluorometric detection, LC-MS/MS and mouse bioassay. *Toxicol*, **2010**, *55* 724-733.

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Archaeometry Center

Introduction

Archaeometry is the science that combines historical-artistic research with qualitative and quantitative measurements obtained using analytical methods of physics, chemistry and biology. The Archaeometry Center of the University of Ioannina was recently established as member of the network of the horizontal laboratories of the University of Ioannina. Its aims include the search for specialised information from archaeological artefacts, monuments, works of art and materials, which are the major components in the building of civilisation and culture.

The region of Epirus (North –Western Greece) is endowed with its own natural beauty and cultural identity. The first traces of human presence in the area, dating back to 40.000 BC, were discovered in the Asprohaliko cave of Haradra on the Louros River. Important findings were also unearthed from caves in the Vikos Gorge, proving that life continued without a break up to the Mesolithic era. This is confirmed by the discovery of the prehistoric settlement of Kastritsa, (5000 B.C.) With the start of the Middle Helladic period (1.900 - 1.550 B.C.), the first Greek tribes settled in Epirus, marking the beginning of a rich history. It is no coincidence that in the Department of History and Archaeology of the University of Ioannina is well known for its research in archaeology.

Infrastructure

Currently, the routinely applied methodologies are:

- Carbon-14 measurements through LSC counting only.
- Tritium dating through LSC counting, with or without enrichment of water samples with electrolysis.
- Thermoluminescence dating.
- Optically stimulated luminescence dating.
- Uranium series dating.

Major equipment available includes:

- A sample preparation laboratory.
- A Tricarb 3170 TR/SL, PACKARD INSTRUMENTS liquid scintillation counter (Fig. 1)
- A TL/OSL DA-15C/D Reader from Riso equipped with PC installed software to control the reader and for data acquisition (Fig. 2)
- Electrolysis equipment for tritium enrichment (Fig.3)
- Optical microscopes with on line computer connection (Radon Unit, Nuclear Physics laboratory)

Archaeometry studies are supported by other techniques, such as Scanning Electron Microscopy (SEM Unit), X-ray fluorescence spectroscopy (XRF Unit) and X-ray diffraction (XRD Unit).



Figure 1: General view of the temporary installations of Tricarb 3170 TR/SL liquid scintillation counter.



Figure 2: View of the TL/OSL DA-15C/D Reader from Riso.



Figure 3. Electrolysis equipment for tritium enrichment.

Services

Activities of the Archaeometry Center are not limited to the archaeology field only. The applications for the dating methodologies cover a broad spectrum, from archaeology and geology to materials and environmental sciences. When it will be fully operative, the activities of the Center will include the following:

Carbon-14 dating

Radiocarbon (^{14}C) is the radioactive isotope of the common element carbon. It is formed in the upper levels of the atmosphere following the interaction of cosmic rays with nitrogen (N_2). Then radiocarbon is oxidised to carbon dioxide (CO_2) and is diffused in the atmosphere. As carbon dioxide is used for photosynthesis, radiocarbon is integrated into all organisms. When a plant or an animal dies, radiocarbon decays with a half-life of 5730 years. At the radiocarbon dating laboratory the amount of remaining radiocarbon relative to the stable element is measured. Since radiocarbon's half-life is known, the age of the sample can be estimated.

Tritium dating

Tritium, the heaviest isotope of hydrogen, is radioactive and has a half-life of 12.4 years. Water in contact with the atmosphere will have some tritium in it, and this tritium will be decaying to a stable, inert isotope called helium-3. Tritium can be effectively used to investigate hydrologic mixing and transport processes. Due to its short half-life and steady state concentration, tritium is the ideal tracer for studies requiring a time resolution to the nearest month over the past 150 to 200 years. In using tritium as a hydrological tracer, the analysis should be conducted at the lowest practical detection levels because of the inherently low tritium levels found in natural waters (2 to 20 Tritium Units, or TUs (3.2pCi/L)). Through electrolytic enrichment of tritium in water samples prior to measurement, these low detection levels may be reached, affording greater accuracy and precision.

Uranium series dating

Uranium series dating is based on the radioactive decay of uranium in calcium carbonate and other minerals that precipitate from solution. Natural ^{238}U decays into ^{234}Th , while the other isotope of U, ^{234}U , decays into ^{230}Th . Because uranium is soluble in water and thorium is not, minerals that precipitate from solution often contain U but very little Th. Through time Th is formed in the mineral as the U decays. The Th is itself a radioactive element and it decays into daughter products (i.e. ^{234}Th decays into ^{234}U and ^{230}Th decays into ^{226}Ra). Ra is also radioactive, and it decays into Rn in a very short time.

If the mineral is of sufficient age, it contains the entire chain of U decay products, from ^{238}U through to ^{206}Pb . The critical elements in this series are ^{238}U , ^{234}U and ^{230}Th because of their half-lives. For any mineral that initially contained only U, the time since its formation can be calculated from the $^{238}\text{U}/^{234}\text{U}$ and $^{234}\text{U}/^{230}\text{Th}$ ratios.

Luminescence dating

Luminescence is the emission of light from non-conducting solids in addition to thermal radiation. It is caused by the stimulation of trapped electrons in crystal defects and/or impurities, and their subsequent recombination with emission of light. Ionizing radiation from natural radioactivity and cosmic rays produces free charge carriers, which are partly stored in the crystal lattice. Since the concentration of the charge carriers increases with time, their numbers and thus the intensity of the luminescence signal can be employed for dating.

The phenomenon of luminescence can be categorised according to the form of energy supply during the stimulation process as:

- Thermoluminescence (TL, stimulated by heat)
- Optical stimulated luminescence (OSL, stimulated by visible light)
- Infrared stimulated luminescence (IRSL, stimulated by infrared light)
- Radioluminescence (RL, stimulated by ionizing radiation)

Fission tracks dating

Minerals containing trace amounts of uranium register the decay of the uranium-238 isotope by spontaneous nuclear fission in the form of fission tracks. These tracks are formed along the trajectories of the nuclear fragments ejected by the fissioned uranium nucleus. The lattice damage along a track is gradually restored at elevated temperatures, resulting in a decrease of the length of the fission track. Fission-track research is concerned with the study the fission-track record in natural crystals with the aim of determining the geological age and temperature history of the rock that contains them. Fission-track dating is based on measurements of the number of tracks that have accumulated since the crystal last cooled below the temperature at which the tracks are retained.

Staff & Contact Information

The Archeometry Center is supervised by a Scientific Committee composed of academic staff members from the University of Ioannina. Information can be obtained by contacting:

Dr. Kostas Ioannides (Head of the Unit),

E-mail: kioannid@cc.uoi.gr, *Tel:* +30 26510 08545

Dr. Kostas Stamoulis (Scientific staff),

E-mail: kstamoul@cc.uoi.gr, Tel: + 30 26510 08547

Website: <http://omega.physics.uoi.gr/>

Postal address: Nuclear Physics Laboratory, Physics Department, The University of Ioannina, 451 10 Ioannina, Greece

Representative Publications

1. *Determination of ^{226}Ra in aqueous solutions via sorption on thin films and α -spectrometry.* Karamanis, D., Ioannides, K.G., Stamoulis, K.C. 2006, *Analytica Chimica Acta* 573-574, pp. 319-327.
2. *A study of ancient pottery by means of X-ray fluorescence, multivariate statistics and mineralogical analysis.* C. Papachristodoulou, A. Oikonomou, K. Ioannides, K. Gravani *Analytica Chimica Acta* 573-574 (2006) 347-353.
3. *Spatial and seasonal trends of natural radioactivity and heavy metals in river waters of Epirus, Macedonia and Thessalia.* Karamanis, D., Stamoulis, K., Ioannides, K., Patiris, D. 2008 *Desalination* 224 (1-3), pp. 250-260.
4. *Rapid screening of ^{90}Sr activity in water and milk samples using Cherenkov radiation.* Stamoulis, K.C., Ioannides, K.G., Karamanis, D.T., Patiris, D.C., 2007, *Journal of Environmental Radioactivity* 93 (3), pp. 144-156.
5. *Elemental analysis of ancient pottery: a tool for tracing provenance and probing manufacture practices.* C. Papachristodoulou Seminar on “Nuclear Techniques for the Protection of Cultural Heritage Artefacts in the Mediterranean Region”, Athens, 20-22 October 2008.
6. *Assessment of natural radionuclides and heavy metals in waters discharged from a lignite-fired power plant.* Karamanis, D., Ioannides, K., Stamoulis, K. 2009. *Fuel* 88 (10), pp. 2046-2052.

Central Laser Facility

Introduction

The Central Laser Facility (CLF) is involved in studying laser interaction with matter (atoms, molecules, clusters and materials). Laser irradiation may induce selective stimulation, ionization, molecular decomposition, breakdown etc. The information gathered by monitoring the induced ionic current, the energy of the produced electrons and the emitted light, contributes to understanding the structure of materials and their coupling mechanisms with the electromagnetic field of the laser beam. It is further possible to achieve materials' characterization and to develop high sensitivity analytical techniques.

Infrastructure

The equipment currently available in the Center includes (Fig. 1):

- Nd:YAG pumped pulsed dye laser: 3 nsec pulse duration with 150 mJ at 532 nm, covering the 370-1036 nm spectral range
- Nd:YAG pumped pulsed dye laser: 3 nsec pulse duration with 400 mJ at 532 nm, equipped with second harmonic generation crystals able to extend the wavelength range down to 205 nm
- Nd:YAG laser producing light pulses of 35, 50, 100 and 200 psec at 1064 nm (100 mJ), 532 nm (60 mJ), 355 nm (18 mJ), 266 nm (18 mJ) and 213 nm (1 mJ).
- Ti:Sapphire laser producing light pulses of 20 fs (5 mJ, 1KHz), at 800 and 400 nm. The fs laser system is in close connection with a home-made arrangement that produces high-order harmonic pulses (~10 fs) of UV and VUV coherent radiation.

To exploit the laser sources above, a variety of work-stations have been developed, including mass spectrometers, a photoelectron spectroscopy system, a laser-induced fluorescence (LIF) spectroscopy system, arrangements for fast monitoring and analysis of light, for z-scan measurements, for thin film development by pulse laser deposition etc. In case a more specialized experimental setup is needed, the users may provide their own equipment or work with the CLF staff to design and construct new arrangements.

Services

The CLF aims to support research activities in the University of Ioannina and to provide services to social and industrial sectors. Research activities that may be supported include:

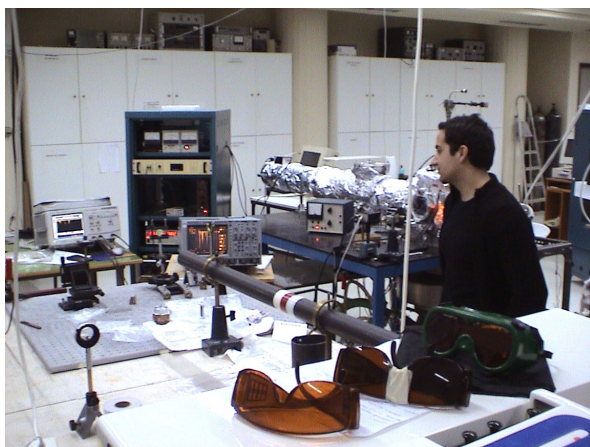


Figure 1: Measuring arrangements at the Central Laser Facility.

- **Physics Department:** Interaction of light with atoms, molecules, clusters, polymers and solids, laser ablation of materials, development of thin films and nanostructures, etc.
- **Chemistry Department:** Photochemistry, laser-induced polymerization, catalysis materials, ultra sensitive analytical and diagnostic techniques, etc.
- **Materials Science and Engineering Department:** Laser ablation, characterization and development of novel materials, micromachining, lithography, etc.
- **School of Medicine:** Diagnostic, therapeutic and surgical techniques for the Clinics and the Pharmacology, Biology and Pathologoanatomy Labs.
- **Department of History and Archeology:** Cleaning and material analysis of objects of Archeological interest, etc

Concerning the services to social and industrial sectors, we can mention the study of pollutants in gaseous, liquid and solid samples, the analytical and diagnostic techniques for product characterization, materials processing, etc.

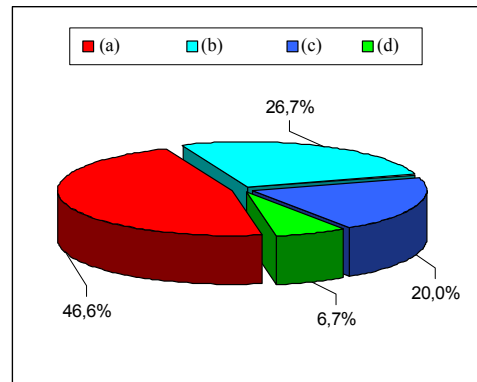
As illustrated in Fig. 2, during the past five year, the CLF has been used by staff members from the Departments of Physics, Chemistry, Materials Science & Engineering and Biological Applications & Technologies. External users from the Aristotle University of Thessaloniki, the National Technical University and the Technical Educational Institute of Crete have also been supported.

Furthermore, the CLF is cooperating with research groups from the Institute of Electronic Structure and Lasers and the Center of Plasma Physics and Laser (Crete), in the framework of the Extreme Light Infrastructure (ELI), High Power Laser Energy Research Facility (HIPER) and X-ray Free Electron Laser (X-FEL) programs. At the European level, the CLF has

developed cooperation with various Research Centers, such as the Rutherford Appleton Laboratory (Oxfordshire-UK), the Max Planck Institute (Munich- Germany), the LENS (Florence –Italy) etc.

It is also worth-noting that the CLF contributes to educational activities in the University, both at the undergraduate and postgraduate level.

Figure 2. Indicative distribution of the CLF operating time between users from the Departments of (a) Physics, (b) Chemistry, (c) Materials Science & Engineering and (d) Biological Applications & Technologies.



Staff & Contact Information

A Scientific Committee, consisting of staff members of the University of Ioannina is responsible for the operation of the Central Laser Facility. Information can be obtained from Prof. C. Kosmidis.

Postal address: Atomic & Molecular Physics Laboratory, Physics Department,
The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-98537

Fax: +30-26510-98695

E-mail: kkosmid@cc.uoi.gr

Representative Publications

1. S. Kaziannis, P. Siozos and C. Kosmidis, "Dynamic alignment of CH3I by strong picosecond pulses", Chem. Phys. Lett. 401, 115 (2005).
2. C. Kosmidis, P.Siozos, S. Kaziannis, L. Robson, KWD Ledingham, P.McKenna, DA Jaroszynski, "On the interaction mechanism of some alkyl iodides with strong femtosecond lasers", J. Phys. Chem. A 109, 1279 (2005).
3. S. Cohen, I. Liontos, A. Bolovinos, A. Lyras, S. Benec'h and H. Bachau, "Two-photon ionization of Calcium above the 3s1/2 threshold", J. Phys. B. v39, 2693 (2006).
4. C. Kosmidis, S. Kaziannis, P. Siozos, A. Lyras, L. Robson, KWD Ledingham, P.McKenna, DA Jaroszynski, "Molecular hydrogen ion elimination from alkyl iodides under strong laser beams irradiation", Int. J. Mass Spectrom. 248, 1 (2006).
5. G.M. Matenoglou, G.A. Evangelakis, C. Kosmidis, and P. Patsalas, "Hybrid pulsed laser deposition of Ti-Cu-N ternary nitride thin films", Reviews in Advanced Materials Science, 15, 38 (2006).
6. S. Kaziannis and C. Kosmidis, "Comparative Study of Multielectron Ionization of Alkyl halides Induced by ps Laser Irradiation", J. Phys. Chem A 111, 2839 (2007).

7. N. Kapakoglou, Betzios P, S. Kazianis, C. Kosmidis, C. Drouza, M. Manos, M. Sigalas, A. Keramidis, and T. Kabanos, "Polyoxomolybdenum(V/VI)-Sulfite Compounds: Synthesis, Structural, and Physical Studies", *Inorganic Chem.* 46, 6002-6010(2007).
8. J.G. Philis and V.S. Melissas, "Resonance-enhanced multiphoton ionization of jet-cooled 2-methylfuran", *Chem. Phys.* 336, 136 (2007).
9. A. Bolovinos, S. Cohen and I. Liontos, "One- and two-photon phase-sensitive coherent control of total ionization yields in the presence of static electric fields", *Phys. Rev. A*, v77, 023413 (2008).
10. G.M. Matenoglou, LE Koutsokeras, Ch E Lekka, G. Abadias, S. Camelio, GA Evangelakis, C. Kosmidis and P. Patsalas, "Optical properties, structural parameters, and bonding of highly textured rocksalt tantalum nitride films", *J. Appl. Phys.* 104, 124907 (2008).
11. E.G. Robertson, D.E. Martin, C.D. Thompson, R.J.S. Morrison and J.G. Philis, "Structure determination of sec-butylbenzene rotamers by UV spectroscopy and an initio calculations", *Chem. Phys. Lett.* 463, 29 (2008).
12. J.G. Philis, "Resonant two-photon ionization spectra of p-difluorobenzene mixed van der Waals complexes", *J. Mol. Struct.* 924, 32 (2009).
13. S. Kaziannis and C. Kosmidis, "The ejection anisotropy in the Coulomb explosion of some alkyl halide molecules under strong ps laser fields", *Chem. Phys. Lett.* 467, 281 (2009).
14. G.M. Matenoglou, Ch.E. Lekka, L.E. Koutsokeras, G. Karras, C. Kosmidis, G.A. Evangelakis, P.Patsalas, "Structure and electronic properties of conducting, ternary $Ti_xTa_{1-x}N$ films", *J. Appl. Phys.* 105, (2009).
15. G.M. Matenoglou, L.E. Koutsoheras, Ch. E. Lekka, G. Abadias, C. Kosmidis, G.A.Evangelakis and P. Patsalas, "Structure, stability and bonding of ternary transition metal nitrides", *Surface and Coatings Technology* 204, 911 (2009).
16. G. Karras, C. Kosmidis, "Multielectron Dissociative Ionization of CH_3I clusters under moderate intensity ps laser irradiation", *International Journal of Mass Spectrometry* 290, 133 (2010).
17. G.A. Almyras, G.M. Matenoglou, P. Komninou, C. Kosmidis, P. Patsalas, G.A. Evangelakis, "On the deposition mechanisms and the formation of glassy Cu-Zr thin films", *J. Appl. Phys.* 107, 084313 (2010).

Magnetic Measurements Unit

Introduction

During the last decade, magnetic measurements have become an essential methodology with a wide range of applications in basic and applied research. They are systematically used in Materials' Technology, Inorganic and Bio-inorganic Chemistry, for the magnetostructural study of various samples. Their industrial applications include quality control of metals and alloys, ceramics and molecular complexes.

Infrastructure

The Magnetic Measurements Unit of the University of Ioannina is equipped with a Vibrating Sample Magnetometer (VSM), Model 7312 of Lakeshore Cryotronics Inc. (Figure 1). Among the three similar instruments that operate in Greece, this is the only one that can reach measurements up to 1000 K.

The technical characteristics of the Vibrating Sample Magnetometer are summarized in the following:

- **Magnetic Moment**
 - Dynamic Region: 5×10^6 emu to 10^3 emu
 - Time Constants: 0.1, 0.3, 1.0, 3.0 or 10 sec
 - Output Stability: Better than $\pm 0.05\%$ for stable temperature and coil geometry in constant field for 24 h
 - Reproducibility: Better than $\pm 1\%$
 - Dynamic Field Region: 0.05 kG to 300 kG
 - Field Stability: Better than $\pm 0.05\%$
 - Field Accuracy: Better than $\pm 1\%$
- Electromagnet Model EM7 – HV
- Cryostat – Oven – Temperature Controller
- Temperature range 2 – 300 K and 300 – 1000 K, respectively
- Power Supply Model 665 Bipolar
- Solid and liquid sample holders
- Controlled by user friendly PC software

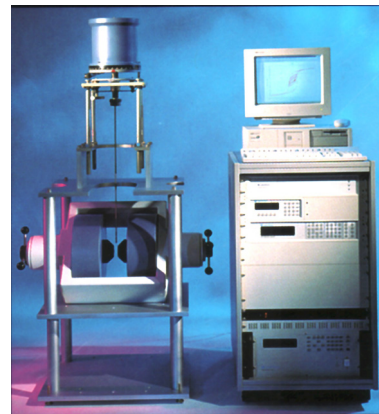


Figure 1: The Vibrating Sample Magnetometer of Lakeshore Cryotronics Inc.

Services

The equipment above has the ability to collect data of magnetic susceptibility and magnetization in a wide temperature region and a magnetic range between 0 and 2 T. The materials that can be studied are:

- Diamagnetics, paramagnetics, ferromagnetics, antiferromagnetics, ferri-magnetics and anisotropic magnetic materials
- High and low temperature superconducting materials (Figure 2)
- Magnetic materials for recording devices (Figure 3)
- Magneto – optic materials
- Metallorganics and metalloproteins
- Amorphous alloys, glasses and high susceptibility alloys
- Permanent magnets, steels (Figure 4), inks etc.
- Thin films, powders and single crystals

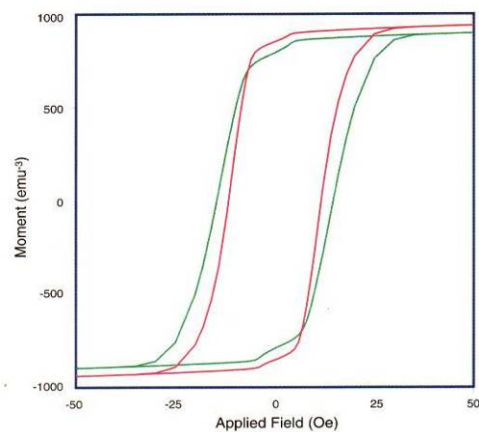


Figure 2: Hysteresis loops from a high temperature semiconductor, at 5, 25 and 50 K.

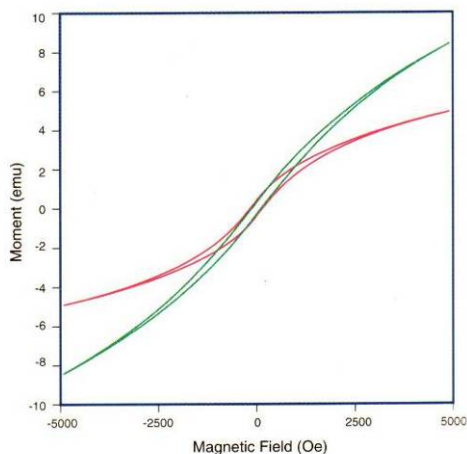


Figure 4: Hysteresis loops for two steels that contain different amounts of chromium.

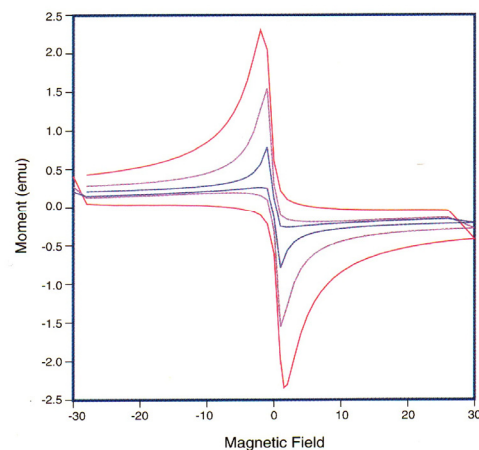


Figure 3: Hysteresis loops from two Nd-Fe-B samples at room temperature.

Staff & Contact Information

A Scientific Committee is responsible for the Unit. Additional information can be obtained by contacting Prof. T. Bakas.

Postal address: Materials Physics Laboratory, Physics Department, The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08512

Fax: +30-26510-08690

E-mail: tbakas@uoi.gr

Representative Publications

1. Comparative Mössbauer and Magnetization study of 1%-¹¹⁹Sn doped La_{0.67}Ca_{0.33}MnO₃ and La_{0.67}Sr_{0.33}MnO₃. Assaridis E., Panagiotopoulos I., Moukarika A., Bakas T., *Phys. Rev.*, *B75*, 224412-6, (2007).
2. Novel Nanohybrids Derived from the Attachment of FePt Nanoparticles on Carbon Nanotubes. Tsoufis T., Tomou A., Gourmis D., Douvalis A.P., Panagiotopoulos I., Kooi B., Georgakilas V., Arfaoui I., Bakas T., *J. Nanosc- Nanotech.*, *8*, 5942, (2008).
3. Magnetic properties of Co films and Co/Pt multilayers deposited on PDMS nanostructures. Markou A., Beltsios K.G., Panagiotopoulos I., Vlachopoulou M.E., Tserepi A., Alexandrakis V., Bakas T., Dimopoulos T., *J.M.M.M.*, 321(17), 2582, (2009).

Thermal Analysis Unit

Introduction

The Thermal Analysis Unit (TAU) employs some common techniques to monitor changes in the physical properties of materials, induced by a controlled heating or cooling program or following interactions with one another (reaction, dissolution, adsorption etc.). The basic techniques used in the TAU, as well as the properties being measured, are listed in Table 1.

Table 1. Thermal techniques available in the TAU.

Technique	Measured property
Thermogravimetry (TGA)	Mass
Derivative thermogravimetry (DTG)	>>
Differential thermal analysis (DTA)	Temperature
Differential scanning calorimetry (DSC)	Enthalpy
Thermodilatometry (TD)	Dimensions
Dynamic Mechanical Analysis (DMA)	Deformation/Viscoelasticity

Infrastructure

The following equipment is available at the TAU:

- The thermal analysis instrument STA 449C *Jupiter*[®] (Fig. 1), designed to simultaneously measure the mass changes (TG) and the calorimetric effects (DSC or DTA) at both high and low temperature. The TG technique measures the temperature-induced changes in sample mass. The output signal may be differentiated electronically to yield a DTG curve. The TG technique may be used to study the dehydration, decomposition and thermal stability of solids, to determine their oxidation behaviour and specify the production processes of ceramics and other synthetic materials. Additional information on kinetics and reaction mechanisms may be deduced by treating the TG curves with different methods.
The DTA technique measures the difference in temperature between the sample and a reference material. DTA curves provide information on the temperature range wherein a process takes place and allow calculation of the value of the enthalpy change (ΔH). The DSC technique, although being similar to the DTA, is more accurate and further

determines the heat capacity of the samples. Application of both techniques is very widespread and may be employed in biotechnology, pharmaceuticals and foods, in the study of polymer, inorganic and metallic materials, phase diagrams and purity determination.

- The thermodilatometric instrument DIL 402C (Fig. 2) measures the expansion or shrinkage of a material, which is subject to a controlled temperature-time program. Dilatometric measurements are applicable in ceramics and glass studies, as well as in densification and sintering studies of powders. Both instruments are connected with a data acquisition and control unit, as well as with a PC through the SW/STA/652.01 software, which is used for the analysis of results. Additional software packages are available, namely PEAKSEP and KINETICS, which perform peak separation of curves and kinetics analyses, respectively.
- The C 80 II calorimeter (Fig. 1) is used to measure the heat exchange and may provide useful information on the behaviour and thermal properties of the materials (such as fusion, polymerization, decomposition, oxidation, heat capacity) or the materials brought together (reaction, dilution, hydration, wetting). The instrument is also suitable for simulating mixing reactions (liquid-liquid, liquid-solid) and thermal transformation. The above equipment is connected to a data acquisition and control unit, as well as to a PC equipped with the SW/STA/652.01 software, which may be used for data analysis and kinetics calculation.
- The DMA 242C (NETZSCH) instrument is used to measure the mechanical properties of materials, under an oscillating stress as a function of temperature, time and frequency (DIN 53513, DIN 53440, DIN-IEC 1006, ASTM D 4065, ASTM D 4092, ASTM D 4473, ASTM D 5023, ASTM D5024, ASTM D 5026, ASTM D 5418). Structural changes, such as the glass-transition temperature, secondary transitions, cross-linking etc, may thus be determined.



Figure 1: The STA 449C JUPITER equipment that combines TG/DTG, DTA and DSC techniques (on the right) and the SETARAM C80 calorimeter (on the left).

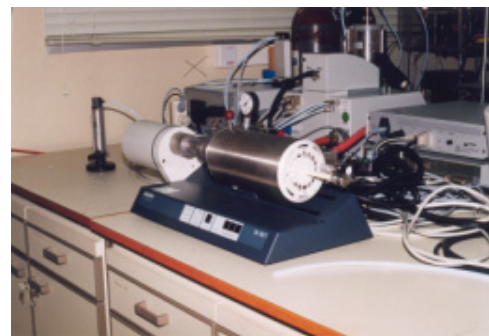


Figure 2: ThermoDilatometry equipment, NETZSCH model DIL 402 C.

Services

The Unit is engaged in activities, such as:

University research activities

Department of Chemistry

- Laboratory of Industrial Chemistry (materials, catalysts, polymers and minerals)
- Laboratory of Inorganic Chemistry (complexes and zeolites)
- Laboratory of Physical Chemistry (materials)

Department of Physics

- Laboratory of Materials Science (superconductors, semi-conductors, polymers)

Department of Materials Science & Engineering

- Materials' studies, synthesis and characterization

Industrial research activities (R & D programs)

- Product characterization
- Thermal stability of construction materials, alloys, glass objects and packaging materials
- Metal Oxidation

Staff & Contact Information

A Scientific Committee is responsible for the Unit. Information can be obtained by contacting Prof. T. Vaimakis:

Postal address: Industrial Chemistry Laboratory, Chemistry Department, The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08352

Fax: +30-26510-44836

E-mail: tvaimak@cc.uoi.gr

Representative Publications

1. G.C. Koumoulidis, C.C. Trapalis, and T.C. Vaimakis, "Sintering of Hydroxyapatite Lath-like Powders", *J. Thermal Anal. Calorim.*, 84, 165 (2006).
2. T.C. Vaimakis, E.D. Economou, and C.C. Trapalis, "Calorimetric Study of Dissolution Kinetics of Phosphorite in Diluted Acetic Acid", *J. Thermal Anal. Calorim.*, 92, 783 (2008).
3. N. Todorova, T. Giannakopoulou, T. Vaimakis, G. Romanos and J. Yu, C. Trapalis, "Preparation of fluorine doped TiO₂ photocatalysts with controlled crystalline structure" *Inter. J. Photoenergy*, Art. No. 534038 2008
4. A. Giannakas, C. G. Spanos, N. Kourkoumelis, T. Vaimakis and A. Ladavos, "Structure and Thermal Stability of Polystyrene/Layered Silicate Nanocomposites", *Composite Interfaces* 16, 237 (2009)

5. Anastasios I. Mitsionis, Tiverios C. Vaimakis, “A Calorimetric Study of the temperature effect on Calcium Phosphate precipitation”, *J. Thermal Anal. Calorim.*, 99, 785 (2010).
6. A.J. Mitsionis, T.C. Vaimakis, and C.C. Trapalis, « The effect of citric acid on the sintering of the calcium phosphate bioceramics”, *Ceramic International*, 36, 623 (2010).
7. G.I. Chilas, N. Lalioti, T. Vaimakis, M. Kubicki, and Th. Kabanos, “Hydrothermal syntheses, crystal structures and physicochemical properties of 2-D and 3-D inorganic coordination cobalt(II)-sulfite polymers”, *Dalton Trans.*, (2010), (accepted).
8. K. Mahmud, T.C. Vaimakis, A.J. Mitsionis, and C.C. Trapalis, “The Threonine Effect on Calcium Phosphate Preparation from a Solution Containing Ca/P=1.33 Molar Ratio”, *Ceramic International*, (2010), (accepted).



Cancer Biobank Center

Introduction

The University of Ioannina Cancer Biobank Center (UICBC) is a repository and advanced lab facility that stores blood and tissue samples, tumor cells and genetic material (DNA-RNA) from cancer patients who have voluntarily donated it to the UICBC with the aim to be used for Academic cancer research.

The scope of UICBC is to bring about advancements in Academic cancer research and ultimately to assist the international fight against cancer and improve overall management of human cancer. The privacy of “donators” is maintained by restricting access to researchers and those who have permission to access the information.

Scientific Background

Genetic research published with increased frequency in high profile scientific journals reveal the extreme complex nature of cancer which is apparently associated with the clinical inability to successfully tackle the disease^[1]. Furthermore it is now well known that in depth understanding of underlying molecular mechanisms cannot be achieved using traditional study methods such as simple genetic and/or protein disorders^[2]. The leading scientific intuition is that the answer to a variety of clinical questions in relation to prevention, diagnosis as well as the individualized treatment and follow-up of cancer patients, is lying in the systematic study of good quality biological material from a large number of cancer patients^[3]. This fact has led to the understanding of the urgent need for establishing Cancer Biobanks and link them in networks, which offers major advantages for the analysis of cancer genetic background and the diagnostic evaluation of patients with hereditary predisposition to cancer aiming eventually to the ultimate clinical benefit of patients.

The use of bioinformatics in analysing Biobanks’ data is considered a sine-qua-non means towards this effort. It is important to note that a significant number of academic institutes in Europe, America and other countries have already proceeded in the establishment of Cancer Biobank Centers. In addition to that, the European Union is supporting towards the formatting of an inter-European Cancer Biobank Network for academic research purposes as well as for the economical independency of European institutes from research products, which are exclusively made in the USA

In 2007, a group of clinical and basic scientists of the University of Ioannina, who engulfed similar scientific concerns and shared common interests, teamed up and proceeded to the founding of UICBC. Today, UICBC is a member of the Biobanking and Biomolecular Resources Research Infrastructure (BBMRI) of the integrate Europe’s existing biobanks into a single network.

[1] Lewis R: Genes versus cancer. *Nature* 2007, 446(7137):826-827.

[2] Butler D: Translational research: crossing the valley of death. *Nature* 2008, 453(7197):840-842.

[3] Roukos DH, Murray S, Briasoulis E: Molecular genetic tools shape a roadmap towards a more accurate prognostic prediction and personalized management of cancer. *Cancer Biol Ther* 2007, 6(3):308-312.

Infrastructure

UICBC (Biological Material Storage Unit and Research Laboratories) are located in the premises of the Medical School of Ioannina University in appropriately designed and reformed buildings.

Up to date the UICBC is equipped with a variety of instruments, some of which are: -30°C and -80°C freezers, PCR machines, microscopes, real time PCR platform for 96 and 384 samples (LightCycler® 480 Real-Time PCR System), Bioanalyzer Aginet 2100, 2D electrophoresis system Agilent 3100 etc.

Services

The targets of the UICBC include:

- The secured collection and storage of quality biological samples using validated methods from cancer patients who have consented to the donation.
- The production of valid doctoral and postdoctoral research in the fields of molecular biomarkers and molecular targets aiming to prevention and/or therapeutic specificity enabling eventually the successful use of individualized cancer treatment.
- The theoretical and practical training of undergraduate and post-graduate students in advanced techniques of molecular cancer research.
- The collaboration of the UICBC with other National and International Academic Institutes on common research projects.

Staff & Contact Information

The UICBC is supervised by a Scientific Committee composed of academic staff members from the University of Ioannina. Information can be obtained by contacting:

- M. Fatouros (mfatouros@cc.uoi.gr) (Head of the UICBC)
- I. Sainis (isainis@cc.uoi.gr) (Technical staff)
- V. Kounnis (vkounnis@cc.uoi.gr) (Administrative staff).

Tel: +30-26510-07713

Representative Publications

1. Chira P., Vareli K., Sainis I., Papandreou C., Briasoulis E., *Alterations of MicroRNAs in Solid Cancers and Their Prognostic Value*. *Cancers*, 2010. 2(2): p. 1328-1353.
2. Sainis I., Fokas D., Vareli K., Tzakos A., Kounnis V., Briasoulis E., *Cyanobacterial Cyclopeptides as Lead Compounds to Novel Targeted Cancer Drugs*. *Marine Drugs*, 2010. 8(3): p. 629-657.

Research Center for Scientific Simulations

Introduction

The Research Centre for Scientific Simulations (RCSS) is part of the “Network of Research Supporting Laboratories” at the University of Ioannina. The mission statement of the Centre is to provide computer time for running large scale parallel simulations. The basic infrastructure of the Centre was installed in December 2006, in the framework of the project “*Development of the Research Centre for Scientific Simulations*” and was financed by the Region of Epirus. The system is an important computational asset that contributes in research and educational activities carried out at the University Ioannina.

Infrastructure

The hardware infrastructure (Figure 1) consists of 200 worker nodes, each having two (2) independent central processors AMD Opteron™ 248 2.2 GHZ. Consequently, the total number of available processors is four hundred (400). Each worker node includes 4GB ECC memory, 80GB local disk and two 1Gbps network ports. The worker nodes are interconnected by a high capacity (>380Gbps) ethernet switch. Central storage for the applications is provided by a disk array (raid 5) over NFS.

The infrastructure is supported by cooling systems with capability up to 400 KBTU/h and uninterrupted power supply (UPS) with capability up to 120 KVA. Also, the installation includes a set of systems and services that monitor the operation of the infrastructure. Moreover, for handling and distributing user jobs, an appropriate resource management software is installed.



Figure 1: Research Centre of Scientific Simulations.

Services

The RCSS provides the opportunity for academic researchers at the University of Ioannina, to perform large scale parallel simulations in various research fields (Chemistry, Materials Science, Medicine, Mathematics, Biology, Economics, Computer Science, etc). Access to the infrastructure has been requested by 50 users, 26 of them consumed more the 1000 hours and are considered by convention as regular users. During the past three years, user applications consumed a total of 5630 Khours.

Indicatively, it is reported that during the past three year (Figure 2), the computational resources of the Centre have been used by researchers in the Departments of Chemistry, Materials Science and Engineering, Mathematics, Economics, Computer Science and the School of Medicine. In addition the Centre contributes in the training of post graduate students.

Finally, in the framework of the European project “Enabling Grids for E-science” (EGEE III), part of the infrastructure was connected with the European Computational Grid (EGEE).

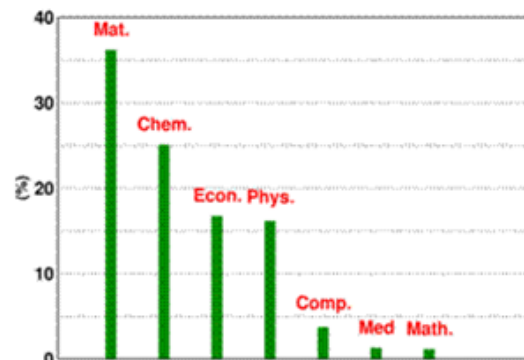


Figure 2: Indicative time distribution of RCSS's resources

Staff & Contact Information

The RCSS is supervised by a Scientific Committee composed of academic staff members from the University of Ioannina. Information can be obtained by contacting Prof. I. Lagaris.

Postal address: Department of Computers' Science, The University of Ioannina, 451 10 Ioannina, Greece

Tel: +30-26510-08804

E-mail: lagaris@cs.uoi.gr

Representative Publications

1. A. C. Tsipis, “Upright or In-Plane Conformational Preference: Dilemma of η^2 -Coordinated C=C Double Bond in $PtX_2(CO)(\eta^2\text{-ene})$ (X=H, Cl or C_6F_5) Complexes”, *Organometallics* 27, 3701 (2008).
2. A. T. Chaviara, E. E. Kioseoglou, A. A. Pantazaki, A. C. Tsipis, P. A. Karipidis, D. A. Kyriakidis, C. A. Bolos, “DNA interaction studies and evaluation of biological activity of homo- and hetero-trihalide mononuclear Cu(II) Schiff Base complexes”, *Quantitative structure-activity relationships J. Inorg. Biochem.* 102, 1749 (2008).
3. K. Christopoulos, K. Karidi, A. C. Tsipis and A. Garoufis, “Synthesis, characterization, DNA-binding properties and electronic structure (DFT) of Ruthenium oligopyridine complexes”, *Inorganic Chemistry Communications* 11, 1341 (2008).
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10. C. Voglis, P.E. Hadjidoukas, I.E. Lagaris, D.G. Papageorgiou, “A numerical differentiation library exploiting parallel architectures”, Computer Physics Communications, in press (2009).
11. D.A. Kilimis and D.G. Papageorgiou, “Structural and electronic properties of small bimetallic Ag–Cu clusters”, Eur. Phys. J. D 56, 187 (2010).
12. G.A. Almyras, Ch.E. Lekka, N. Mattern and G.A. Evangelakis, “On the microstructure of the Cu₆₅Zr₃₅ and Cu₃₅Zr₆₅ metallic glasses”, Scripta Materialia 62, 33 (2010).
13. Stavrakoudis A., “Computational modelling and molecular dynamics simulations of a cyclic peptidomimotope of the CD52 antigen complexed with CAMPATH-1H antibody”, Molecular Simulation, in press, (2010).
14. D.A. Kilimis, D.G. Papageorgiou, “Density functional study of small bimetallic Ag–Pd clusters”, Journal of Molecular Structure: THEOCHEM, in press, (2010).
15. G. V. Papamokos, I. G. Tsoulos, I.N. Demetropoulos, E. Glavas, “Location of Amide I mode of vibration in computed data utilizing constructed neural networks”, Accepted for publication in Expert Systems With Applications.
16. M. Guffey, E. Lidorikis, X.-M. Lin, J.D. Joannopoulos and N.F. Scherer, “Plasmon Delocalization in Au Nanoparticle Monolayer Arrays Established by Optical Experiments and Simulation”, to be submitted Journal of Physical Chemistry C.
17. S. Egusa, E. Lidorikis, M. Guffey, X.-M. Lin, J.D. Joannopoulos, and N.F. Scherer, “Resonant transmission of coherent light through 2D metallic nanocrystal arrays”, to be submitted in Phys. Rev. B.
18. Ch. E. Lekka, N. Panagiotopoulos, Ph. Komninou, P. Patsalas, G.A. Evangelakis, “Electronic properties and bonding characteristics of AlN:Ag Thin Film Nanocomposites; a computational and experimental study”, to be submitted in Acta Materialia.

CONTACT GUIDE

Nuclear Magnetic Resonance Center Department of Chemistry	Head: I. Gerothanassis (igeroth@uoi.gr) Technical Staff: V. Exarchou (vexarc@cc.uoi.gr), C. Tsiafoulis (ctsiafou@cc.uoi.gr) Tel: +30 26510 08334, 8315
Scanning Electron Microscopy Unit Department of Chemistry	Head: P. Pomonis (ppomonis@cc.uoi.gr) Tel: +30 26510 08350
Confocal Laser Scanning Microscopy Unit Medical School	Head: Th. Fotsis (thfotsis@uoi.gr) Tel : +30 26510 07560
Powder X-Ray Diffraction Unit Department of Physics	Head: T. Bakas (tbakas@uoi.gr) Tel: +30 26510 08350
Single Crystal X-Ray Diffraction Unit Department of Chemistry	Head: S. Skoulika (vskoul@uoi.gr) Technical Staff: V. Dokorou (dokorou@cc.uoi.gr) Tel: +30 26510 08446, 8445
X-Ray Fluorescence Spectroscopy Unit Department of Physics	Head: K. Ioannides (kioannid@cc.uoi.gr) Technical Staff: C. Papachristodoulou (xpapaxri@cc.uoi.gr) Tel: +30 26510 08545, 8548
Mass Spectrometry Unit Department of Chemistry	Head: G. Varvounis (gvarvoun@cc.uoi.gr) Tel: +30 26510 08382
Archaeometry Center Department of Physics	Head: K. Ioannides (kioannid@cc.uoi.gr) Technical Staff: K. Stamoulis (kstamoul@cc.uoi.gr) Tel: +30 26510 08545, 8547
Central Laser Facility Department of Physics	Head: K. Kosmides (kkosmid@uoi.gr) Technical Staff: S. Danakas (sdanakas@uoi.gr) Tel: +30 26510 08537, 8514
Magnetic Measurements Unit Department of Physics	Head: T. Bakas (tbakas@uoi.gr) Tel: +30 26510 08350
Thermal Analysis Unit Department of Physics	Head: T. Vaimakis (tvaimak@cc.uoi.gr) Tel: +30 26510 08352
Cancer Biobank Center Medical School	Head: M. Fatouros (mfatouro@cc.uoi.gr) Technical Staff: I. Sainis (isainis@cc.uoi.gr), Contact: V. Kounnis (vkounnis@cc.uoi.gr) Tel: +30 26510 07713
Research Center for Scientific Simulations Students' Restaurant Building	Head: I. Lagaris (lagaris@cs.uoi.gr) Staff: E. Vamvakopoulos (evamvak@cs.uoi.gr) Tel: +30 26510 08804, 8864

Website: <http://www.uoi.gr/services/lab-net/>



NETWORK OF RESEARCH SUPPORTING LABORATORIES OF THE UNIVERSITY OF IOANNINA

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